Wide Wavelength Range Spectral Emissivity of the Solid and Liquid States up to 2500 K

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Thermal radiative properties of materials are important in many processes of elaboration at high temperature (industrial furnaces), for heat insulator calculation (spatial application) or for the temperature measurement by infrared pyrometry or thermography. We need spectral emissivity not only of the solid state, often the measurement on the liquid is of great interest. We developed, on the base of an infrared spectrometer, an experimental device for the direct measurement of the emissivity in a large range of temperature (500-2 500 K) and a wide domain of frequency (10-12 500 cm-1, 1 000 to 0.8 µm). The sample temperature is measured at the Christiansen point, a particular frequency for which the polar dielectric materials behave as a blackbody. We focused the design on the problem of the measurement of the radiative properties of semi transparent compounds. The aim of this presentation is to point out the performances of this apparatus. So we will illustrate with the measurements of the spectral emissivity for dielectric semi-transparent porous media in the solid state and above the melting point on the liquid. Porous materials include heterogeneities (pore, grain) in their bulk. They are the origin of scattered radiation, involving changes of optical properties. The comparison between spectral emissivity of porous materials (alumina ceramics, silica with bubbles) and homogeneous one shows the influence of the texture and the porosity. The model is based on a 3D off-lattice reconstruction of porous media and a Monte Carlo simulation by ray tracing, based upon the classical laws of the geometrical optics. We apply this model on data obtained for some oxide samples from solid to liquid phase.